LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Scientific Queries

MAY I venture to ask you, or one of your readers, for information on the following points:—

1. What is Le Verrier's Law of Storms?

2. What the latest state of our knowledge regarding the peculiar changes undergone by the Mexican Axolotls during their metamorphoses? Have changes, similar to those observed in 1866 by Duméril been noticed in the Zoological Gardens or elsewhere? Have any observations regarding generation in the so-called Pereniobranchiates been made on any other animals besides the Axolotl and the Siredon?

3. Where can I find any account of the earliest observations on the peculiar nesting arrangements of the Hornbills, as described by Wallace? I see that Captain Layard has sent a note on this subject to the Zoological Society, but I have no means of ascertaining what he states.

4. In a lecture published by Blanchard in the *Revue des Cours Scientifiques* a few months ago, on the Progress of Natural History in the Departments of France (excluding Paris), I see that a medal has been lately awarded to M. Lespes for his entomological researches. Are these recent researches, or are they those described several years ago by Mr. (now Sir John) Lubbock in the *Natural History Review?*

5. Is it not the general opinion of your readers that Sir John Lubbock would confer a great favour on those who possess the first edition of his *Prehistoric Times*, by publishing in the form of a pamphlet the chief additions which are introduced into his second edition?

F. R. S.

Haze and Dust

DR. TYNDALL, in his lecture upon Haze and Dust, says "that if a physician wishes to hold back from the lungs of his patient, or from his own, the germs by which contagious disease is said to be propagated, he will employ a cotton-wool respirator;" and, further on, "time will decide whether in lung diseases also the woollen respirators cannot abate irritation, if not arrest decay."

May I ask if there is any necessity for the unsightly respirators one sees over the mouths of people during the winter months and cold evenings? Has not Nature already provided us with an efficient one—one which, on experiment, will doubtless prove to be quite as trustworthy as the artificial one, without any of its inconveniences? I refer to the hair-sieve with which the sinuosities of the nasal passages are supplied; the hairs besetting its path freeing the indrawn air from contaminating particles of dust, whilst it is effectually warmed in its inward passage.

That the air is thus filtered might, I think, be ocularly demonstrated by inhaling exclusively through the nostrils, and then expiring through the glass tube, when the floating matter will be found absent, having been arrested in the nose; I suggest this experiment, because, from the eminent professor applying a handful of wool to his *mouth* and *nose*, I infer that he did not give his natural respirator a fair chance of showing its capabilities.

Apart from the use of respirators, *en passant*, I may perhaps be allowed to echo the opinion of our best medical men in saying that the mouth is not *the* organ for respiration; if it were, should we not find the olfactory nerves developed there also? By respiring through the mouth you do not properly exercise your sense of smell, you allow the hairs lining the nasal cavities to dwindle away and become suppressed through non-use, and finally, you clog up the minute tubercles of the lungs with all kinds of rotten matter.

It is a well-known fact, that people who habitually breathe through the nose are less liable to infectious diseases and pulmonary complaints, one very common benefit derived by such who sleep with the mouth closed, is that they never awake with the painful and disagreeable sensation produced by a parched throat and cracked lips. This may be a small matter, but I think it is deserving of attention. When we break Nature's laws we must pay the penalty.

A. L.

The Solution of the Nile Problem

I HAVE read with much pleasure Mr. Keith Johnston's remarks in your impression of the 27th ult. on the subject of Dr. Livingstone's explorations, not only because they manifest an intimate acquaintance with the general physical features of the field of inquiry and a proper estimate of the merits of the question; but because they help to establish the correctness of my opinion, that the Chambeze and its lakes belong to the Nile system, and not to that of the Congo. I have only to explain that, in my letter of December 1st (NATURE, No. 9), I did not "give the opinion that the river which forms the main part of the great traveller's latest discoveries is *the head stream* of the Nile," but merely said that it "joins" it.

On the question of levels your correspondent is substantially correct, and if he will look to the *Illustrated Travels* of the 1st inst., he will see how far I agree with him. From Dr. Livingstone's statements it appears that the general drainage level of the basin of the Chambeze does not exceed 3,000 feet; and it is not improbable that in the passage of the waters northwards on the west side of Tanganyika, they fall two or even three hundred feet lower, so as to descend nearly if not entirely to the level of the Albert Nyanza. But even if this be the case, I fail to see how the difference in height, however small, "could not give a sufficient lowness to the latter lake (Albert Nyanza) to allow this river (Chambeze) to flow down to it through the five degrees of latitude which separate them." The levels of the Lakes Liemba, Tanganyika, and Albert Nyanza—of which the first is in about 10° S. lat. and the last has its northern end in about 3° N. lat.—are respectively *circa* 2,800, 2,844, and 2,720 feet; and as the continuity of these three bodies of water is assumed by Mr. Keith Johnston, it follows that there is here a virtual dead level extending over not five, but *thirteen* degrees of latitude, or 780 geographical miles! If then it is possible for the waters of Lake Liemba, the head of Livingstone's "eastern line of drainage," to flow into the Albert Nyanza, it is equally possible for those of the Chambeze and its lakes, forming that traveller's central line of drainage, to do so.

In his last letter from Ujiji, Dr. Livingstone says that "the western and central lines of drainage converge into an unvisited lake west or south-west of this"—that is to say, situated in the unexplored regions west of Tanganyika, in the north-north-west direction in which he saw the Lualaba (as he calls the lower course of the Chambeze) flowing, after it had emerged from the crack in the mountains of Rua, north of Lake Moero. This "unvisited lake" is evidently the Lake Chowambe of the traveller's former communications, which by his now calling Baker's Albert Nyanza by the name of "Nyigi Chowambe," he would seem to identify with it. But this is quite consistent with Baker's own statement, that, to the south of about 1° 30′ S. lat., the Albert Nyanza "turns suddenly to the west, in which direction its extent is unknown."

"Albert Nyanza," "Nyigi Chowambe," and this "unvisited lake west or south-west of Ujiji," are, therefore, one continuous body of water, which, being on the lowest level of all, must form not merely the "western line of drainage," but the *main* drainage of the upper Nile Basin; and as, on its eastern side, it is the recipient of the waters of the lakes Victoria Nyanza and Tanganyika, so, on its western side, it receives those of the great lake discovered by Signor Piaggia, with an elevation (as I believe) of four or five thousand feet.

This is entirely in accordance with the opinion I have always entertained that the water-parting between the basin of the Nile and those of the rivers flowing into the Atlantic—the Ogowai the Kuango (Congo), the Kwanza, and the Kunene—is on about the twentieth meridian of east longitude, as it is, in fact, marked on my maps of "The Basin of the Nile" of 1849, 1859, and 1864. The Mossamba range of mountains, situate to the east of the Portuguese colony of Benguela, on the west coast of Africa, forms the southern extremity of this water-parting, and it is in these mountains that I find the head of the great river, which with the Lufira forms Livingstone's "western line of drainage," or, as it should be more correctly designated, the main stream of the Nile. This river is the Kasái, Kassávi, or Loke, whose sources are in the forests of Quibokoe or Kibokoe, on these Mossamba Mountains, within 300 miles of the Atlantic Ocean; which river was crossed by Dr. Livingstone within 160 or 170 miles of its head, on February 27th, 1854, in his adventurous journey across the African continent, and is described by him in page 332 of his "Missionary Travels," and the lower course of which river was followed down by the Hungarian traveller, Ladislaus Magyar, in 1850, as far as about 6° 30′ S. lat., *where he heard that it flowed eastward into Lake "Nhanja"*—a statement strikingly in accordance with Mr. Cooley's assertion, adverted to in my former communica-

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tion, that "the drainage of the Cazembe's country is all into the Nyanza on the east."

The Nile of Egypt, in thus having its source at the opposite side of the continent of Africa, within a short distance of that ocean into which it does *not* flow, only follows an almost general law of Nature. In the *Athenæum* of July 22nd, 1865, when commenting on Sir Samuel Baker's announcement of his discovery of the Albert Nyanza, I compared the Nile and its Lakes with the Po and its Lakes, pointing out how the two rivers have some of their sources in *snowy* mountains, not at the extremity but at the side of their respective basins. Dr. Livingstone's present discoveries seem to establish the fitness of this comparison, and to extend it. For as the Po, whose exit is in the Adriatic, has its head sources in the Cottian and Maritime Alps, within a few miles of the Gulf of Genoa; so, in like manner, the Nile, which flows into the Mediterranean, has its head on the Mossamba Mountains, within 300 miles of the Atlantic Ocean.

The spot which I have thus discovered to contain the hitherto hidden Source of the Nile, and so to reveal

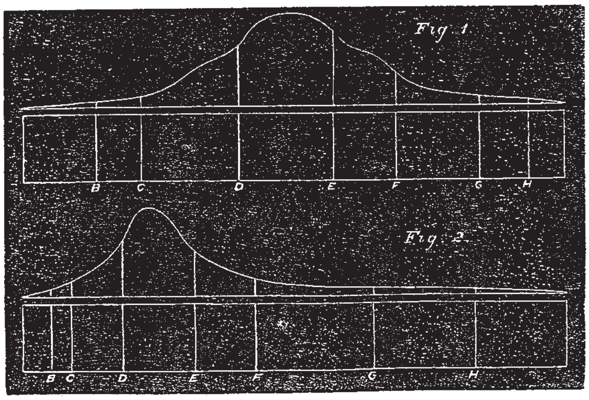
> —fluori causas per sæcula tanta latentes,
> Ignotumque caput,

is the most remarkable culminating point and water-parting of the African Continent, if not of the whole world; for, within the space of a degree east and west (between 18° and 19° E. long.) and half as much north and south (between 11° 30′ and 12° S. lat.) it includes not only the head of the mighty Nile, which runs northwards over one-eighth of the entire circumference of the globe, but likewise those of the Kuango, (Congo), the Kuanza and the Kunene flowing westwards; those of the Kuivi and the Kubango running to the south; and that of the Lungebungo having its course eastward and forming the head stream of the Zambesi. It is, in fact, what I have been endeavouring to determine since 1846, "the great *hydrophylacium* of the continent of Africa, the central point of division between the waters flowing to the Mediterranean, to the Atlantic, and to the Indian Ocean" (*Journal of the Royal Geographical Society*, vol. xvii. p. 82), as likewise to Lake Nyami, or some other depression in the interior of the continent.

Bekesbourne, Feb. 2 CHARLES BEKE

Analogy of Colour and Music—Supernumerary Rainbows

IN what I saw of a recent discussion in your paper as to the analogy between the colours of light and musical notes, I did not observe any reference made to an analogy on this subject, published, I believe, in 1845, by Prof. Mossotti, of Pisa. The analogy is pointed out at the end of a paper concerning the diffraction spectrum. This spectrum, the disposition of the colours in which depends solely on the wave-lengths, has its point of maximum brightness in the middle, which in this spectrum is occupied by a shade of colour rather nearer to the line E than D. Fig. 1 represents the positions of the lines in the diffraction spectrum; and fig. 2 represents the spectrum formed by refraction through a certain flint glass prism which belonged to Fraunhoffer. The ordinate of the curve which is drawn above each spectrum represents the intensity of the light at each place of that spectrum. The curve drawn above fig. 2 is that due to Fraunhoffer's actual observations with the prism above referred to. The intensity of the light in the neighbourhood of the principal lines is given by him by the following numbers :—



B	C	D	E	F	G	H
·032	·094	·64	·48	·168	·031	·0056

These intensities were determined by comparison with the light of a lamp placed at various distances. It is hard to say, however, what physical and physiological facts are included in these numbers.

The curve given in fig. 1 is constructed by Mossotti analytically, on a principle which amounts to this :—He takes hold of the spectrum in fig. 2, and shifts it so that the fixed lines come into the positions of fig. 1, and decreases or increases the ordinate representing the brightness in the neighbourhood of each fixed line in exactly the proportion that the spectrum has been expanded or contracted in the neighbourhood of that line. The change of place of portions of colour not in the immediate neighbourhood of one of these lines is regulated by a formula founded on a certain physical investigation of Mossotti's as to the dependence of the refraction index upon the wave-length, which formula has its constants determined by the method of least squares, so as to represent with sufficient accuracy the truth at the fixed lines.

Following a method similar to that adopted by Newton, Mossotti supposes the spectrum in fig. 1 to be bent round the complete circumference of a circle, and he finds that if x be the wave-length in millionths of a millimetre at a point distant by an arc whose circular measure is x, from the brightest portion of the spectrum, then x is given for the fixed lines with sufficient accuracy by the formula

$$x = 553{\cdot}5 + 184{\cdot}5\,\frac{\phi}{\pi},$$

extending this formula to the ends of the spectrum, it constrains the longest wave-length to be 738, and the shortest 369 millionths of a millimetre. This result Mossotti regards as sufficiently near the actual wave-lengths of the extremities of the spectrum.

The longest and shortest wave-lengths taken in conjunction with the wave-lengths of the brightest part of the diffraction spectrum and of the fixed lines B C D E F G H form ten wave-lengths, which Mossotti thus compares with the notes of the diatonic scale :—

1	$\frac{17}{25}$	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{25}{18}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{13}{8}$	2
$\frac{1}{738}$	$\frac{1}{688{\cdot}3}$	$\frac{1}{656}$	$\frac{1}{590}$	$\frac{1}{553{\cdot}5}$	$\frac{1}{531}$	$\frac{1}{492}$	$\frac{1}{443}$	$\frac{1}{393{\cdot}5}$	$\frac{1}{369}$
738	688	656	589	553·5	526	484	429	393	369
—	B	C	D	—	E	F	G	H	—

The first line represents the number of vibrations necessary to produce the notes of the diatonic scale. The numbers in the second line have the same ratio as the numbers in the first, and therefore the denominators of these fractions represent the wave-lengths of the respective notes. The third line represents the lengths in millionths of a millimetre of the waves corresponding to the lines respectively placed under them.

I need not here give any opinion as to the utility or inutility of such analogies, but I shall be glad if this letter should call the attention of any of your readers to the remarkable symmetry of the diffraction spectrum, which is in fact Nature's own graphical method of exhibiting the numerical wave-lengths which correspond to each part of the spectrum.

Trinity College, Cambridge, Feb. 9 JAMES STUART

IN your journal of January 20th Mr. Grove has honoured my little note on "Colour and Music" by a letter on the subject, in which attention is directed to a rainbow, or series of rainbows, *within* the primary. Mr. Grove asks if a description of this phenomenon has been published, and whether the effect may not be a repetition of the colours of the spectrum after the manner surmised by Sir John Herschel. I will endeavour as briefly as possible to reply to these inquiries.

So far as I can trace, the mention of inner or "supernumerary" bows first occurs in the Phil. Trans. for 1722, p. 241. It is there described by a Dr. Langwith, who had seen the phenomenon no less than four times in the course of that year. On one occasion it was so favourably seen, and lasted so long, that he is able to give the following careful description. Under the usual primary bow, Dr. Langwith says, "was an arch of green, the upper part of which inclined to bright yellow, the lower to a more dusky green; under this were alternately two arches of reddish purple and two of green, under all a faint appearance of another arch of purple, which vanished and returned several times so quick that we could not readily fix our eyes on it."

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